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OPERATING SYSTEM-1 (GATE 2023) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) | CORRECT(10) | INCORRECT(3) | SKIPPED(4)

Q. 11 Have any Doubt ?

Consider a system uses inverted page table mechanism for paging. Physical address space is 32 bit and logical address space for a process is 42 bit. Page size is 16 KB. System allow maximum 200 processes concurrently. Each page table entry contains 4 extra bits for management purpose, process-id and page number. What is the size of page table in above system?

A 1.2 MB

B 1.25 MB — Correct Option

Solution :
(b)

$$\begin{aligned}
\text{Page size (PS)} &= 16\ \text{KB} \\
\text{Page offset (PO)} &= \log_2(\text{PS}) = \log_2(2^{14}) = 14\ \text{bits} \\
\text{Number of frames} &= \frac{\text{Memory size}}{\text{PS}} = \frac{2^{32}}{2^{14}} = 2^{18} \\
\text{Page number length (PN)} &= 42 - \text{PO} \\
&= 42 - 14 = 28\ \text{bits} \\
\text{Bits for process id} &= \lceil \log_2(\text{max processes}) \rceil \\
&= \lceil \log_2(200) \rceil = 8\ \text{bits} \\
\text{Page table entry (PTE)} &= (\text{Process-id bits}) + (\text{Page number length}) + (\text{Extra bits}) \\
&= 8 + 28 + 4 = 40\ \text{bits} \\
\text{Page table size} &= \text{Number of frames} \times \text{PTE} \\
&= 2^{18} \times \frac{40}{8}\ \text{Bytes} = \frac{5}{4}\ \text{MB} \\
&= 1.25\ \text{MB}
\end{aligned}$$

C 1.5 MB

D 1.75 MB

QUESTION ANALYTICS +

Q. 12 Have any Doubt ?

Consider a system has memory partitions 200 KB, 600 KB, 100 KB, 300 KB and 500 KB in given order on a particular state. At this state, system need to allocate memory to five processes P_0, P_1, P_2, P_3 and P_4 in given order. Size of processes P_0, P_1, P_2, P_3 and P_4 are 234 KB, 440 KB, 80 KB, 240 KB and 320 KB respectively. If a process cannot get memory then system put this process on hold and allocate memory to next available process. Which of the following statement is incorrect for next-fit and best-fit algorithm used for above situation? Assume that in next-fit if system reached last available partition then next partition to this is first available partition in order, and initially pointer is on first available partition.

A 100 KB and 300 KB partitions will not be used in next-fit algorithm.

B Only 200 KB partition will not be used in best-fit algorithm.

C Process P_4 has to wait in next-fit.

D Process P_4 has to wait in best-fit. — Your answer is **Correct**

Solution :
(d)

Next-fit

	→ 200	600	100	300	500
P_0		−234			
	200	→ 366	100	300	500
P_1					−440
	200	366	100	300	→ 60
P_2	−80				
	→ 120	366	100	300	60
P_3		−240			
	120	→ 126	100	300	60
$P_{4=320}$					

P_4 has to wait for free available partition of size ≥ 320 KB.
And 100 KB, 300 KB not used here.

Best-fit

	200	600	100	300	500

P_0					-234
	200	600	100	66	500
P_1					-440
	200	600	100	66	60
P_2			-80		
	200	600	20	66	60
P_3		-240			
	200	360	20	66	60
P_4		-320			
	200	40	20	66	60

Here 200 KB partition has not used.
And all processes get memory. So, option (d) is incorrect.

QUESTION ANALYTICS +

Q. 13 Have any Doubt ?

Consider a system has three resources R_0, R_1 and R_2. Four processes P_0, P_1, P_2 and P_3 are executing concurrently. Before starting of a process, each process declare their maximum requirement of each resource instances. Following table Max represent this maximum requirement, where Max$[P_i, R_j]$ contains maximum number of resource instance of R_j required by process P_i. Table Allocated shows number of particular instances of a resource allocated to a particular process. Allocated$[P_i, R_j]$ contain number of instances of R_j allocated to process P_i. At an instance, following are values in table:

Max

	R_0	R_1	R_2
P_0	6	0	5
P_1	5	3	7
P_2	4	9	3
P_3	5	6	4

Allocated

	R_0	R_1	R_2
P_0	4	0	3
P_1	3	2	2
P_2	2	2	1
P_3	3	3	2

Maximum instances of resource R_0, R_1 and R_2 are 14, 10 and 10 respectively.
Which of the following sequence of process is unsafe if unallocated resources allocate in given order sequence?

A P_0, P_1, P_3, P_2

B P_0, P_3, P_1, P_2

C P_3, P_0, P_1, P_2

D P_3, P_1, P_0, P_2 Your answer is **Correct**

Solution :
(d)

Need

	R_0	R_1	R_2
P_0	2	0	2
P_1	2	1	5
P_2	2	7	2
P_3	2	3	2

Allocated resources

R_0	R_1	R_2
12	7	8

Available resources

R_0	R_1	R_2
2	3	2

In option (d),
(i) Allocate resources to P_3, after P_3 available resources
$R_0 = 5$, $R_1 = 6$, $R_2 = 4$
(ii) Now P_1 requires 5 instances of R_2 but we have only 4 instances R_2, so it is unsafe sequence.
For other given sequence, system will not go in deadlock or unsafe state.

QUESTION ANALYTICS +

Q. 14 Have any Doubt ?

Consider a system using inode UNIX-like file system. Disk block size for this system is 1 KB and disk block address is 32 bit long. An inode of this system consists 64 direct, 16 single-indirect, 4 double-indirect, pointers. The maximum possible size of a file in this system is _____ MB.
[Upto 4 decimal places]

260.0625 [260.0620 - 260.0630] Your answer is **Correct**260.0625

Solution :
260.0625 [260.0620 - 260.0630]
Block size = 1 KB
Address length = 32 bit = 4 bytes
1 KB 2^{10}

Number of address in 9 block (n) = $\frac{\text{4 KB}}{\text{4 Bytes}} = \frac{2^{12}}{2^2} = 2^8$

Maximum possible size of a file = (Number of direct pointers + Number of single-indirect × n + Number of double-indirect × n^2) × Block size

$$= [64 + 16 \times 2^8 + 4 \times (2^8)^2] \times 2^{10} \text{ bytes}$$
$$= [2^6 + 2^{12} + 2^{18}]\, 2^{10} \text{ bytes}$$
$$= \left[\frac{1}{2^4} + 2^2 + 2^8\right] \times 2^{20} \text{ Bytes}$$
$$= \left[256 + 4 + \frac{1}{16}\right] \text{MB}$$
$$= 260.0625 \text{ MB}$$

QUESTION ANALYTICS +

Q. 15 Have any Doubt ?

Consider a paging system using 3-level paging for 42 bit logical address space. Page size is 4 KB and each page table fit into a page. This system also uses TLB and TLB entry size is 62 bits. TLB entry consists page number, frame number and 8 extra bits. Page table entry of inner page consists frame number and 8 extra bits. Page table entry size at each level is equal. Let the length of physical address in bits is w. And length of page index in bits are x, y, z from inner level to outer level. The value of $w - x + y + z$ is _____.

46 — Your answer is Correct46

Solution :
46

Page size (PS) = 4 KB = 2^{12} B
Page offset (PO) = $\log_2$ (PS) = $\log_2$ (2^{12}) = 12 bits
Virtual address length (VAL) = 42 bits
Page number length = VAL – PO
= 42 – 12 = 30 bits
TLB entry size (TLBE) = 62 bits
Page number length + Frame number length + Extra bits = 62 bits
30 + Frame number + 8 = 62
Frame number length (FNL) = 24 bits
Page table entry (PTE) size = FNL + Extra bits
= 24 + 8 = 32 bits
Each page table fit into a page, so

$$\text{Number of PTEs in one page table} = \frac{\text{PS}}{\text{PTE}} = \frac{\text{4 KB}}{\text{32 bits}} = \frac{\text{4 KB}}{\text{4 Bytes}} = 4 \text{ K} = 2^{10}$$

Page index length at inner most layer = $\log_2$ (Number of PTEs)
= $\log_2$ (2^{10}) = 10 bits
PTE at each level is same, so other level page number length is also 10.
So, $x = 10,\ y = 10,\ z = 10$
and $x + y + z$ = 30 = page number length
Physical address length = Frame number length + PO
= 24 + 12 = 36 bits
So, $w = 36$
$w - x + y + z = 36 - 10 + 10 + 10 = 46$

QUESTION ANALYTICS +

Q. 16 Have any Doubt ?

Which of the following statements is/are correct?

A. Relative path name and absolute path name for a file or directory cannot be same.

B. Sharing of file or directories is allowed in acyclic-graph directories, but not allowed in treestructured directories. — Correct Option

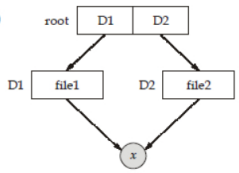
C. An algorithm for searching a file or directly in general-graph directories structure may lead to infinite loop of searching in cycle and never terminate. — Your option is Correct

D. In acyclic-graph directories structure, a file may have multiple absolute path and different file names can refer to same file. — Your option is Correct

YOUR ANSWER - c,d | CORRECT ANSWER - b,c,d | STATUS - ✗

Solution :
(b, c, d)
(a) Relative and absolute path name same for a file or directory from root directory.
(b) In-degree of a node in tree is one except root. So, a file can access from only one directory. But, in graph two node can lead to same node, so sharable file.
(c) General-graph directory can contain cycles, and bad design of searching algorithm may flow infinitely in a cycle.

(d)



Here absolute path of file x can be /D1/file1 and /D2/file 2 and same file x has two names file1 and file2.

QUESTION ANALYTICS +

Q. 17

Have any Doubt ?

Which of the following statements is/are correct?

A. In local replacement algorithm for page replacement, thrashing in one process cannot effect other process entirely.

B. In page-fault frequency strategy, page fault-rate of a process cannot exceed decided upperbound and lower-bound page-fault rate for this process.

C. Increase in degree of multiprogramming can lead to thrashing. Correct Option

D. In global-replacement algorithm for page replacement, the set of pages in memory for a process depend on paging behaviour of this process as well as other processes. Correct Option

YOUR ANSWER - NA | CORRECT ANSWER - c,d | STATUS - SKIPPED

Solution :

(c, d)
(a) If one process is in thrashing, then it will be in queue of paging device, and as queue length increases it will effect other process which uses paging device.
(b) In page-fault frequency strategy, page-fault rate can go beyond decided lower and upper bound. But, when exceed upper bound then allocate new frames to process and if go beyond lower bound then remove frames from process.
(c) High degree of multi-programming → more number of processes → more frame requirement → thrashing.
(d) If a process is in thrashing then in global replacement it can get frames from other processes.

QUESTION ANALYTICS +